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(64) Coating apparatus for sheet-fed, rotary offset printing presses.

(57) A coating apparatus (10) for use in a sheet-fed or web-fed, offset rotary or flexographic printing press (12) to apply a protective and/or decorative coating to the surface of freshly printed sheets (18) includes a doctor blade coating unit (80) coupled to a pickup roller (68) for supplying liquid material from a remote supply drum (102) to sheets transported on the surface of a transfer/delivery cylinder (42) mounted on a press delivery drive shaft (54). Liquid material is circulated through the reservoir (66) of the doctor blade unit by suction flow produced by a return pump (112). This prevents the buildup of positive pressure within the doctor blade reservoir (66). The doctor blade reservoir is maintained at below ambient pressure level, thereby inhibiting leakage through the end seals. A vacuum sensor assembly (122, 128) provides a visual indication of air vacuum pressure in the doctor blade reservoir chamber, and a vacuum sensor switch (132) applies electrical power to an audio transducer (136). The audio transducer produces an audible alarm in response to an increase in doctor blade chamber pressure, thereby providing advance warning of an impending end seal failure or a worn doctor blade (94, 96) condition.

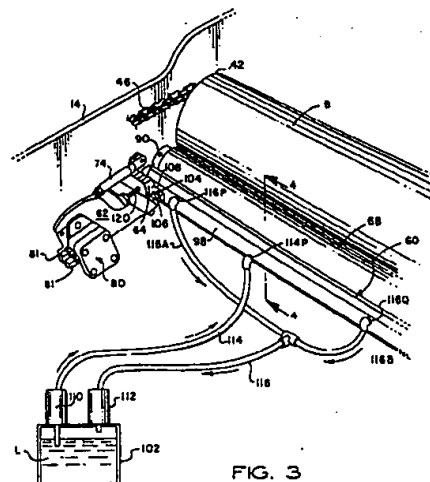


FIG. 3

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This invention is related generally to sheet-fed or web-fed, rotary offset or flexographic printing presses, and more particularly to a new and improved coating apparatus for the in-line application of protective and decorative coatings or inks to the printed surface of freshly printed sheets or web stock.

In some printing applications, it is desirable that the press be capable of applying a protective and/or decorative coating over all or a portion of the surface of the printed sheets. Typical coating solutions include varnish, lacquer, dye, moisturizers and ink. Typically, such coatings are formed of a UV-curable or water-soluble resin applied as a liquid solution or emulsion by an applicator roller over the freshly printed sheets to protect the ink and improve the appearance of the sheets. The use of such coatings is particularly desirable when decorative or protective finishes are required such as in the production of posters, record jackets, brochures, magazines, folding cartons and the like. In applications where a liquid coating is to be applied, the coating operation is carried out after the final ink printing has been performed, most desirably by an in-line coater.

Conventional coating apparatus which is operable as an in-line press operation utilizes an engraved applicator roller, with the liquid coating being applied to the engraved roller by means of a doctor blade assembly. The doctor blade assembly includes an elongated housing having a reservoir chamber extending the length of the applicator roller for holding a volume of coating liquid in wetting contact with the circumferential surface of the applicator roller. A pair of circumferentially spaced doctor blades extend longitudinally along the reservoir housing on either side of the chamber. The doctor blades are angled obliquely toward the applicator roller surface, and seal the doctor reservoir chamber as the blades wipe against the applicator roller surface.

Coating liquid is pumped from a remote supply drum into the doctor reservoir. After the doctor reservoir fills to a certain level, the liquid coating material is returned to the supply drum by gravity flow. Occasionally, the doctor reservoir becomes completely filled with the coating liquid when the volume of coating liquid being pumped into the doctor reservoir exceeds the gravity flow return rate, and the doctor reservoir becomes positively pressurized. The positive pressure may cause the seals at the ends of the applicator roller to leak, allowing the coating liquid to drip onto the press room floor or onto adjacent press parts. The coating liquid may be slung from the applicator roller onto adjacent press equipment and operator areas. Moreover, the buildup of positive pressure within the doctor reservoir accelerates the wear of the end seals.

It will be appreciated that the applicator roller may be operated at high speeds, for example, on the order of 1,000 linear feet per minute (304.8 meters per min-

ute), and that the end seals of the doctor blade assembly will tend to wear quickly. The end seal wear is accelerated by the buildup of positive pressure within the doctor blade chamber. Low volume drip leakage may be collected in a drip pan or catch tray, but as the end seals wear, the coating liquid will be slung from the applicator roller, thereby causing a difficult cleanup problem. When this occurs, the press must be shut down, the doctor blade head must be removed, and the end seals replaced. The steps of rebuilding or replacing the end seals and realigning the doctor blade head involves a substantial amount of unproductive press downtime.

One approach for overcoming the problem of end seal wear is to provide stationary end seals which are mounted on the press frame, and which bear in sealing engagement against the ends of the applicator roller, so that the doctor blade head may form a seal with stationary seals rather than with dynamic seals carried on the applicator roller. Another approach is to use rotary end seals which include an end plate which is resiliently engaged against the end surface of the applicator roller, with a seal member being secured between the end plate and the end portions of the applicator roller by quick release mounting lugs.

While the foregoing mechanical approaches to limiting end seal wear and thereby avoiding leakage have been moderately successful, and some arrangements have reduced downtime by quick change mounting features, the end seals nevertheless are still experiencing accelerated wear and early failure, thereby causing frequent replacements and unacceptable downtime for correction of end seal leakage.

Accordingly, there exists a need for a new and improved in-line coating apparatus for use in a sheet-fed or web-fed, offset rotary or flexographic printing press for applying a protective and/or decorative coating to the printed surface of freshly printed sheets which does not require any expensive or substantial press modification or result in any impairment of normal press operating capability, and which reduces end seal leakage.

The present invention reduces end seal leakage by operating the doctor reservoir at a below atmospheric pressure level. The doctor reservoir is supplied with coating material from a remote supply drum. To insure that an adequate supply of coating liquid is always present within the doctor reservoir, the liquid coating material is drawn from the remote supply drum and is circulated by suction flow through the reservoir. In contrast to the conventional approach of positively pressurizing the doctor blade reservoir with liquid coating pumped from the remote drum to the reservoir, the coating material is instead circulated through the doctor reservoir by suction flow. That is, instead of charging the doctor reservoir with coating liquid pumped from the remote drum and thereby creating a positive pressure condition within the doctor

reservoir, circulation of coating liquid through the reservoir is induced by suction flow provided by a suction pump having an input connected for drawing coating liquid from the doctor reservoir, and returning it by forced (positive pressure) flow to the remote supply drum, rather than by gravity flow return.

As a result of the suction pumping arrangement, the liquid coating material is drawn from the remote supply drum at a greater rate than the rate of transfer of the liquid material by the applicator roller, so that an adequate supply of liquid material will always be present within the doctor reservoir. A benefit of the suction flow arrangement is that a positive pressure condition does not occur within the doctor reservoir. Moreover, liquid material which rises above a predetermined fill level is drawn out of the doctor reservoir by the suction return pump, and is returned to the remote supply drum. Consequently, the end seals are not subjected to high positive pressure conditions. Instead, the suction flow arrangement produces a negative pressure differential, with the doctor reservoir being operated at a below atmospheric pressure level. Under negative pressure conditions, leakage of coating liquid is virtually non-existent, and the operating life of the end seals is substantially increased.

According to another aspect of the present invention, visual and audible alert signals are provided by a vacuum sensor assembly which is coupled to the evacuated space within the doctor reservoir. The sensor assembly includes vacuum gauge which provides a visual indication of the suction pressure within the evacuated space within the doctor reservoir. A vacuum sensor switch is also coupled to the evacuated space for selectively applying electrical power to an audio transducer when the pressure within the evacuated space of the doctor chamber rises above a predetermined safe operating vacuum level.

The operation and advantages of the present invention will be understood from the following detailed description taken with reference to the accompanying drawings wherein:

FIGURE 1 is a schematic side elevational view of a sheet-fed, offset rotary printing press having a coating apparatus embodying the present invention;

FIGURE 2 is an enlarged fragmentary side elevational view taken substantially within the circular area designated "2" in FIGURE 1 and showing the coating apparatus of the present invention during coating operation;

FIGURE 3 is an enlarged fragmentary perspective view showing one side of the coating apparatus mounted in the press and illustrating the fluid path of coating material from a remote supply drum to a doctor reservoir in the coating unit;

FIGURE 4 is an enlarged fragmentary sectional view taken substantially along the line 4-4 of FIGURE 3;

FIGURE 5 is a simplified flow diagram which illustrates a dual pump arrangement for circulating coating liquid from a remote supply drum to the doctor reservoir and return;

FIGURE 6 is a simplified flow diagram which illustrates a single pump arrangement for circulating coating liquid by suction flow from a remote supply drum to the doctor reservoir and return;

FIGURE 7 is an enlarged fragmentary perspective view of one end portion of the doctor blade coating apparatus of the present invention;

FIGURE 8 is an enlarged sectional view taken substantially along the line 8-8 of FIGURE 7; and,

FIGURE 9 is a view similar to FIGURE 8 which includes a suction pressure sensing circuit for providing a visual indication of suction pressure and an audible alert signal when the suction/vacuum pressure inside the evacuated space of the doctor reservoir rises above a safe operating level, thereby signaling an impending or potential failure of the doctor blades or of the end seals.

As shown in the exemplary drawings, the present invention is embodied in a new and improved in-line doctor blade apparatus, herein generally designated 10, for use in applying a protective and/or decorative coating or inks to the freshly printed surface of sheets printed in a sheet-fed or web-fed, offset rotary or flexographic printing press, herein generally designated 12. In this instance, as shown in FIGURE 1, the doctor blade coating apparatus 10 is installed in a four color printing press 12, such as that manufactured by Heidelberger Druckmaschinen AG of the Federal Republic of Germany under its designation Heidelberg Speedmaster 102V, and which includes a press frame 14 coupled at one end, herein the right end, with a sheet feeder 16 from which sheets, herein designated 18, are individually and sequentially fed into the press, and at the opposite end, with a sheet delivery stacker 20 in which the finally printed sheets are collected and stacked. Interposed between the sheet feeder 16 and the sheet delivery stacker 20 are four substantially identical sheet printing stations 22, 24, 26 and 28 which can print different color inks onto the sheets as they are moved through the press 10.

As illustrated, each of the printing stations 22, 24, 26 and 28 is substantially identical and of conventional design, herein including a sheet-fed cylinder 30, a plate cylinder 32, a blanket cylinder 34 and an impression cylinder 36, with each of the first three printing stations 22, 24 and 26 having a transfer cylinder 38 disposed to withdraw the freshly printed sheets from the adjacent impression cylinder 36 and transfer the freshly printed sheets to the next printing station via a transfer drum 40. The final printing station 28 herein is shown as equipped with a delivery cylinder 42 which functions to support the printed sheet 18 as it is moved from the final impression cylinder 36 by a delivery conveyor system, generally designated 44,

to the sheet delivery stacker 20.

The delivery conveyor system 44 as shown in FIGURE 2 is of conventional design and includes a pair of endless delivery gripper chains 46, only one of which is shown carrying at regular spaced locations along the chains, laterally disposed gripper bars 48 having gripper elements 50 used to grip the leading edge E of a sheet 18 after it leaves the nip between the delivery cylinder 42 and impression cylinder 36 of the last printing station 28. As the leading edge E of the sheet 18 is gripped by the grippers 50, the delivery chains 46 pull the sheet 18 away from the impression cylinder 36 and convey the freshly printed sheet to the sheet delivery stacker 20 where the grippers release the finally printed sheet.

The endless delivery chains 46 are driven in synchronous timed relation to the impression cylinder 36 by sprocket wheels 52 fixed adjacent the lateral ends of a delivery drive shaft 54 which has a mechanically geared coupling connected to the press drive system. The delivery drive shaft 54 extends laterally between the sides of the press frame 14 adjacent the impression cylinder 36 of the last printing station 28, and is disposed to be parallel with the axis of the impression cylinder. In this instance, the delivery cylinder 42, which is constructed to allow adjustments in diameter by suitable means, is attached to the delivery drive shaft 54 so that the delivery cylinder is also rotated in precise timed relation with the impression cylinder.

In this respect, it is important to note that when the freshly printed sheets 18 are conveyed away from the impression cylinder 36 of the final printing station 28 by the gripper 50 carried by the delivery chains 46, the wet inked surfaces of the sheets face the delivery drive shaft 54. Consequently, the sheets should be supported such that the wet ink is not smeared as the sheets are transferred. Typically, such support has been provided by skeleton wheels or cylinders mounted to the press delivery drive shaft 54, or as is now more commonly used, net equipped delivery cylinders as described in U.S. Patent 4,402,267 to Howard W. DeMoore, entitled "Method and Apparatus for Handling Printed Sheet Material".

More recently, vacuum transfer apparatus of the type disclosed in U.S. Patent 5,127,329, to Howard W. DeMoore, entitled "Vacuum Transfer Apparatus for Sheet-Fed Printing Presses", has been used. The vacuum transfer apparatus may be used in place of delivery cylinders or skeleton wheels to pull the unprinted side of the sheet away from the delivery drive shaft 54 so that the wet ink surface of the sheets do not come into contact with any press apparatus.

In accordance with the present invention, the inline doctor blade coating apparatus 10 for applying the protective or decorative coating or ink to the sheets 18 enables the press 12 to be operated in the normal manner without the loss of the final printing station 28, and without requiring any substantial press

modifications by employing the existing press delivery drive shaft 54 as the mounting location for a delivery transfer cylinder 42 which has been equipped with a liquid material coating blanket B. In presses having delivery systems such as skeleton wheels mounted on the delivery drive shaft 54 or a vacuum transfer apparatus as disclosed in U.S. Patent 5,127,329, conversion to a coating operation may be quickly and easily accomplished by mounting on the press delivery drive shaft 54 in place of the skeleton wheels or in addition to the vacuum transfer apparatus, a blanket-equipped delivery transfer cylinder 42 capable of performing a blanket coating function as well as the delivery transfer function. By utilizing a blanket modified delivery cylinder 42 mounted on the delivery drive shaft 54 to also act as a blanket cylinder, protective coating may be applied to the printed sheet 18 in precise timed registration, and will permit the press 12 to be operated with its full complement of printing stations.

For that purpose, the coating apparatus 10 of the present invention includes a relatively simple, positive acting and economical doctor blade coating unit, generally designated 60, mounted to the press frame 14 downstream of the delivery drive shaft 54 and positioned to apply liquid coating material to the coating blanket B mounted on a delivery transfer cylinder 42 which is secured to the delivery drive shaft 54. As shown in FIGURES 2, 3 and 4, the doctor blade coating unit 60 herein comprises a pair of side frames 62, only one of which is shown, it being understood that the other side frame is substantially the same as that of the side frame illustrated, attached to each side of the press frame 14. Pivotaly mounted to one end of each of the side frames 62 is a support bracket 64 carrying one end of a doctor blade reservoir 66 and a cooperating liquid material applicator roller 68 each disposed to extend laterally across the press 12 parallel with the delivery drive shaft 54. The coating unit 60 is mounted between the upper and lower runs of the delivery chains 46 downstream of the delivery drive shaft 54, and positioned so that the outer peripheral surface 70 of the applicator roller 68 can be engaged against the coating blanket B on the delivery cylinder 42 mounted on the delivery drive shaft 54.

As shown in FIGURES 2 and 3, the support bracket 64 is pivotally attached to the end of the side frame 62 by a shaft 72 disposed at the lower end portion of the bracket, and can be pivoted about the shaft by an extensible cylinder 74, herein shown as a pneumatic cylinder, one end 76 of which is secured to the side frame, and the opposite end 78 of which is coupled through a pivot shaft 79 to the upper end portion of the bracket. By extending or retracting the cylinder 74, the extent of engagement of the applicator roller 68 against the surface of the coating blanket B of the delivery cylinder 42 may be controlled, and the appli-

cator roller 68 may be completely disengaged from the transfer coating blanket B in an idle position.

The coating applicator roller 68, which is of conventional design and preferably having an engraved ceramic or chrome outer peripheral surface 70, is designed to pick up a predetermined volume of liquid coating material or ink from the doctor reservoir 66, and then uniformly transfer the liquid coating material to the blanket B on the transfer delivery cylinder 42. To effect rotation of the applicator roller 68, a drive motor 80, either hydraulic or pneumatic, is attached to one of the side frames 62 and coupled to a source of pressurized fluid (not shown) through fittings 81A, 81B. Attached to the output of the drive motor 80 is an output gear which is drivingly coupled through a cluster gear 82 and a series of idler gears 83 each mounted on stub axes 84, to a drive gear 88 attached to the end of a shaft 88 on which the applicator roller 68 is concentrically mounted. The shaft 88 of the applicator roller 68 is, in turn, journaled at each end to the tracksets 64 through a releasable semicircular collar 90 attached by bolts 92 to the bracket. Herein, the axle of the terminal idler gear, designated 83', also serves as the shaft 72 for pivotally mounting the support bracket 64 to the side frame 62 so that when the bracket is rotated about the shaft, the terminal idler gear remains engaged with the drive gear 88 of the pickup roller 68.

In this arrangement, as can best be seen in FIGURE 4, the applicator roller 68 has a peripheral surface portion 68P which projects radially into the doctor blade reservoir 66 containing a supply of coating material or ink. A pair of upper and lower inclined doctor blades 94 and 96 attached to the doctor blade head 98 on shoulders 98A, 98B engage the applicator roller surface to doctor the excess liquid coating material or ink picked up from the reservoir by the engraved surface 70 of the roller.

The reservoir cavity 66 is formed within an elongated doctor blade head 98 having a generally C-shaped cross-section with an opening 100 extending longitudinally along one side facing the applicator roller 68. The reservoir 66 is supplied by flow circulation means with liquid material or ink drawn from a supply drum 102 disposed at a remote location within or near the press 12. Preferably, the doctor blade head 98 is removably attached to the brackets 64, herein by bolts 104 having enlarged, knurled heads 106, and which can be threaded through slots 108 formed in the brackets to clamp the reservoir in place on the brackets.

To insure that an adequate supply of liquid coating material is always present within the doctor reservoir 66 and to prevent coagulation and clogging of the doctor blades 94 and 96 by the liquid coating material or ink, the coating material or ink is circulated through the doctor reservoir by flow circulation means comprising at least one suction pump, and preferably by

a supply pump 110 and a return pump 112 as shown in FIGURE 5, and supply and return conduits 114, 116. The supply pump 110 draws the liquid material L from the supply drum 102 via a supply conduit 114 and discharges it into a bottom region of the doctor reservoir 66 through a delivery port 114P, and the return pump 112 induces suction flow in a pair of return conduits 116A, 116B coupled adjacent an upper evacuated chamber region of the reservoir through return ports 116P, 116Q for withdrawing excess liquid coating material or ink from the reservoir. By supplying the coating material or ink from the supply drum 102 at a greater rate than the rate of transfer of liquid material by the applicator roller 68, an adequate supply of coating material or ink will always be present within the doctor reservoir 66. The excess coating material or ink which rises above the liquid level of the return port R (FIGURE 8) is suctioned away by the suction return pump 112.

According to an important feature of the present invention, the doctor reservoir 66 is not pressurized as taught by the prior art. Instead, coating liquid or ink is supplied to the doctor reservoir 66 by the suction flow produced by the return pump 112. In this arrangement, the return pump 112 applies a vacuum or suction force in the doctor reservoir which draws liquid material L from the supply drum 102 through the supply conduit 114 to the doctor reservoir 66 and draws excess liquid material L from the doctor reservoir 66 through the return conduit 116 into the remote supply drum 102 at a rate which is greater than the rate that liquid coating material or ink is being supplied to the doctor blade reservoir through the supply conduit 114. Because the suction return flow rate is greater than the supply flow rate, excess coating material and air are evacuated from the upper chamber region of the doctor reservoir, a positive pressure condition within the doctor reservoir is avoided, and a below atmospheric vacuum pressure level is established.

Referring to FIGURE 5, FIGURE 6, FIGURE 7 and FIGURE 8, the liquid material L is delivered by the supply conduit 114 through a supply port 114P into the lower region of the doctor reservoir 66, and is withdrawn from the doctor reservoir through a return port 116P in an upper chamber region of the chamber through the return conduits 116A, 116B. The liquid level elevation of the return port 116P is preferably selected to provide for the accumulation of liquid coating material or ink in more than about half of the doctor reservoir, thereby insuring that the engraved surface of the applicator roller 68 will be thoroughly wetted by the coating material or ink L as it turns through the doctor reservoir. The doctor reservoir 66 is bounded vertically by lower and upper doctor head shoulders 98A, 98B. Accordingly, the return ports 116P, 116Q of return lines 116A, 116B are located at a liquid level R intermediate the limits establish-

ed by the lower and upper shoulders. Any excess liquid coating material or ink which rises above the liquid level R of the return ports will be suctioned away by the return pump 112.

It will be appreciated that the supply pump 110 is optional, and that the suction circulation system may be operated effectively with only the single suction return pump 112 as shown in FIGURE 6. In the single pump configuration, it may be necessary to prime the supply conduit 114 to obtain satisfactory operation. The two pump arrangement as shown in FIGURE 5 is preferred for those installations in which the supply drum 102 is located at a distance that is too far from the press to achieve adequate suction flow. The auxiliary supply pump 110 provides positive flow input to the doctor blade reservoir at a fixed flow rate. The return suction pump 112 has a faster suction return flow rate than the supply flow rate. Consequently, a positive pressure buildup in the doctor reservoir cannot occur. By utilizing two pumps as shown in FIGURE 5, the liquid level within the doctor reservoir 66 may be closely controlled, without positive pressure buildup, thereby reducing leakage through the end seals.

Referring to FIGURE 8, it will be appreciated that the doctor reservoir 66 is maintained at a pressure level below atmospheric by the suction action of the return flow pump 112. The coating liquid L rises to the liquid level of the return port R and is drawn off immediately by the suction pump 112. Additionally, air within the doctor blade chamber 66 is also evacuated, thereby reducing the doctor blade chamber pressure to a level below ambient atmospheric. This negative pressure differential condition opposes leakage of coating liquid L through the end seals. Since the doctor reservoir 66 is not positively pressurized, the end seals are operated under favorable pressure differential conditions, thereby extending their useful lifetime. Moreover, the negative pressure differential doctor blade assembly will accommodate an applicator roller having a chipped corner, which would leak under positive pressure conditions, but which does not leak because of the negative pressure reservoir condition established by suction flow.

It is useful for the press operator to have an advance warning of an impending end seal failure. With advance warning, the press operator can schedule repair and/or replacement of the doctor blades and the end seals at a convenient time, for example between press runs or before undertaking the next printing job. Apparatus for monitoring the suction/vacuum condition within the doctor chamber 66 is provided by a pneumatic sensor assembly 120 as shown in FIGURE 9. The pneumatic sensor assembly 120 includes a pneumatic sensor line 122 which is coupled in fluid communication with the doctor blade chamber 66 through a vacuum sensor bore 124 formed through the upper doctor head shoulder 88B. The vacuum sensor line 122 is coupled to the sensor bore

124 by a threaded fitting 126.

Continuous monitoring of the vacuum/suction condition within the doctor reservoir 66 is provided by a vacuum gauge 128 which can be of any conventional design, for example a Bourdon gauge which is calibrated for dry air and covers a range from about zero to about twenty torrs (about 20 millimeters of mercury). The vacuum gauge 128 is coupled into the sensor line 122 by a tee coupling 130. According to this arrangement, the press operator receives a continuous visual indication of the vacuum/suction condition within the doctor blade chamber 66.

According to another aspect of the invention, the vacuum/suction line 122 is coupled to a vacuum switch 132. The vacuum switch 132 has a conductive, movable diaphragm 134 which is movable into and out of electrical contact with switch electrodes 132A, 132B. That is, the diaphragm 134 is pulled out of contacting engagement with the switch electrodes 132A, 132B when the vacuum/suction level in the doctor reservoir 66 is below a predetermined level. When the pressure level within the doctor reservoir 66 rises above that preset level, for example in response to leakage of air through the end seals or around a worn doctor blade 94, the vacuum pressure within the vacuum chamber 132C of the sensor switch also rises, thereby permitting the conductive switch element 134 to engage the switch electrodes 132A, 132B.

When switch closure occurs, electrical power is applied to an audio transducer 136 from a power source 138. Electrical current is conducted through the pneumatic switch 132 to the audio transducer 136 through power conductors 140, 142. According to this arrangement, the press operator will receive an audible alert as soon as the suction/vacuum pressure in the doctor blade chamber rises above a safe operating level, thereby signaling wear failure of the doctor blades and/or an impending failure of the end seals.

From the foregoing, it should be apparent that the coating apparatus 10 of the present invention provides a highly reliable, effective and economical in-line apparatus for applying coating material to the freshly printed sheets 18 in a sheet-fed, offset rotary printing press 12 which allows the final printing station to continue to be used as a print station, yet which does not require any substantial press modification or the addition of a separate timed applicator roller, and which inhibits end seal leakage.

Claims

1. Coating apparatus (10) for applying liquid material (L) from a supply drum (102) to an applicator roller (68) which is engagable in an operative position with a doctor blade head (60) having an elongated reservoir (66) for receiving liquid material from the supply drum, said doctor blade head be-

ing adapted to extend in parallel with the applicator roller in the operative position with a portion of the peripheral surface (68P) of the applicator roller extending into said reservoir for wetting contact with liquid material contained therein, and including doctor blade means (94, 96) attached to the doctor blade head for engagement against the peripheral surface of the applicator roller in the operative position, characterized in that

circulation means are coupled to the doctor reservoir (66) for inducing the flow of liquid material from said supply drum into the doctor reservoir and for returning liquid material by suction flow from the doctor reservoir to the supply drum.

2. Coating apparatus (10) as defined in claim 1, said circulation means comprising
 - a supply conduit (114) connecting the supply drum in flow communication with the doctor reservoir;
 - a return conduit (116) connecting the doctor reservoir in flow communication with the supply drum; and,
 - a first pump (112) coupled in series flow relation with the return conduit for inducing suction flow of liquid material from the supply drum through said supply conduit into the doctor reservoir, and for inducing suction flow of liquid material from the doctor reservoir through the return conduit into the supply drum.
3. Coating apparatus (10) as defined in claim 2, wherein the return conduit (116) is coupled in flow communication with the doctor reservoir (66) at a first liquid level location (116P) and the supply conduit (114) is coupled in flow communication with the doctor reservoir at a second liquid level location (114P), the first liquid level location of the return conduit being higher in elevation than the second liquid level location of the supply conduit when the doctor blade head (60) is in the operative position.
4. Coating apparatus (10) as defined in any one of claims 1 to 3 wherein said circulation means comprises:
 - a second pump (110) coupled in series flow relation with said supply conduit (114) for pumping liquid material (L) from the supply drum (102) to the doctor reservoir (66).
5. Coating apparatus (10) as defined in claim 4, characterized in that the suction return pumping rate of said first pump (112) is greater than the supply pumping rate of said second pump (110).
6. Coating apparatus (10) as defined in any one of

the preceding claims wherein the doctor blade head (60) has first and second shoulders (98A, 98B) forming lower and upper liquid level boundaries for said reservoir, respectively, and said circulation means includes a return conduit (116) coupled in flow communication with said reservoir (66) at a liquid level location (R) disposed intermediate the liquid level boundaries established by said first and second shoulders.

7. Coating apparatus as defined in any one of the preceding claims wherein a pneumatic conduit (122) is coupled to the reservoir (66) for sensing air vacuum pressure within the reservoir, and a vacuum gauge (128) is coupled to the pneumatic conduit for providing a visual indication of air vacuum pressure in the reservoir.
8. Coating apparatus as defined in any one of claims 1 to 6 wherein a pneumatic conduit (122) is coupled to the reservoir (66) for sensing air vacuum pressure within the reservoir, a vacuum responsive switch (132) having switch electrodes (132A, 132B) is coupled to said pneumatic sensor conduit, and an audio transducer (136) is electrically connected to the switch electrodes for making and breaking an electrical circuit from a power source (138) to said audio transducer.
9. Coating apparatus (10) as defined in any one of the preceding claims wherein means are coupled to the reservoir for supplying and evacuating liquid material to and from the reservoir (66) at differential flow rates, respectively, whereby a lower chamber region of the reservoir is maintained in a filled condition and an upper chamber region of the reservoir is maintained in an evacuated condition.
10. Coating apparatus (10) as defined in any one of the preceding claims wherein means (62, 64) are provided for mounting the coating apparatus on the side frame (14) of a printing press (12) adjacent to a transfer delivery cylinder (42), a liquid material coating blanket (B) is secured to the transfer delivery cylinder, and including means (74) for extending the applicator roller (68) into engagement with the coating blanket in the operative position, and for retracting the applicator roller out of engagement with the coating blanket in an idle position.

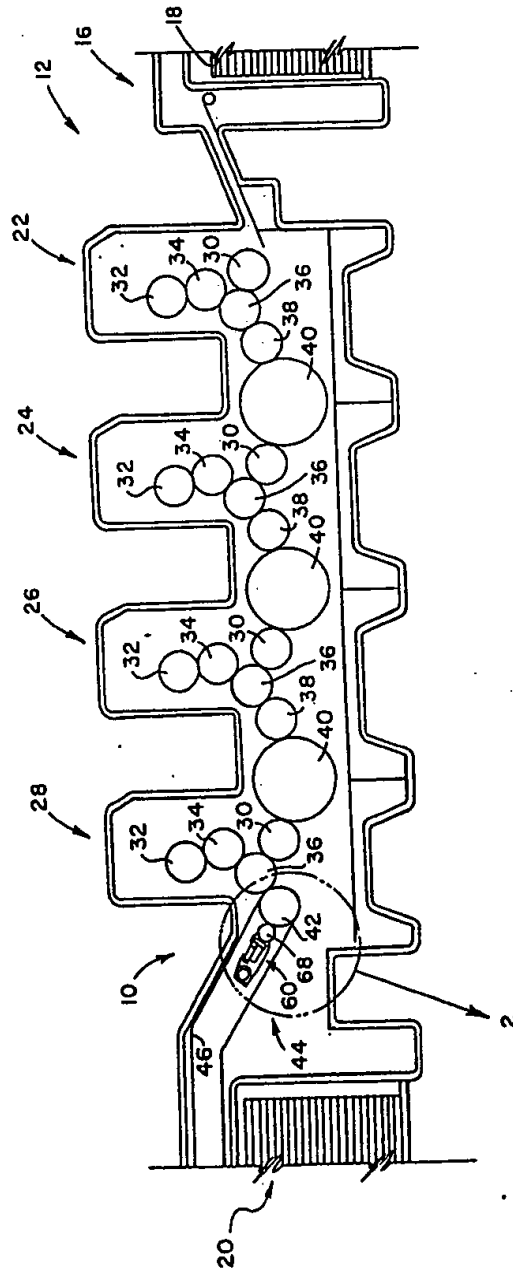


FIG. 1

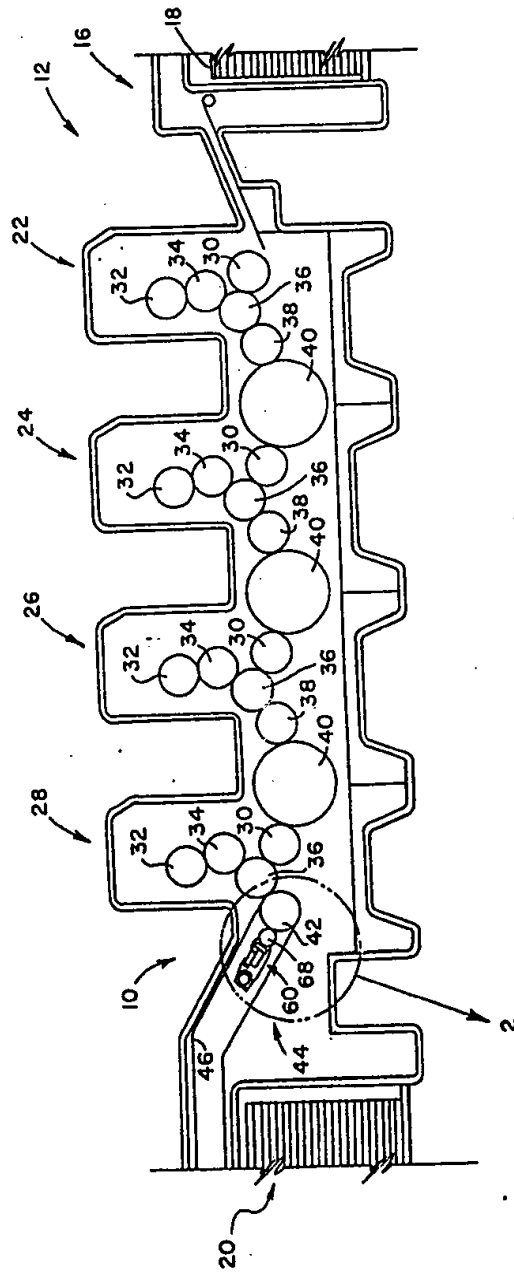


FIG. 1

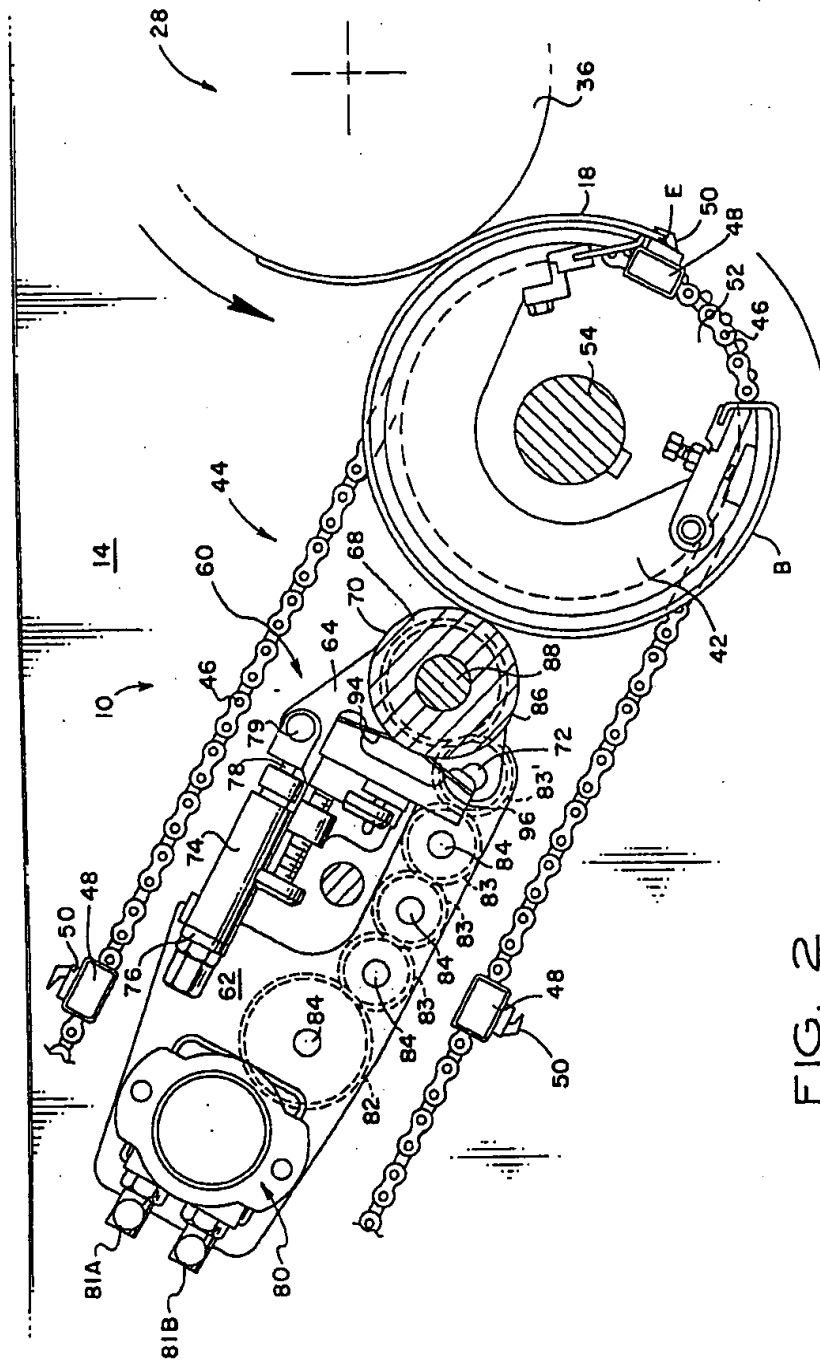


FIG. 2

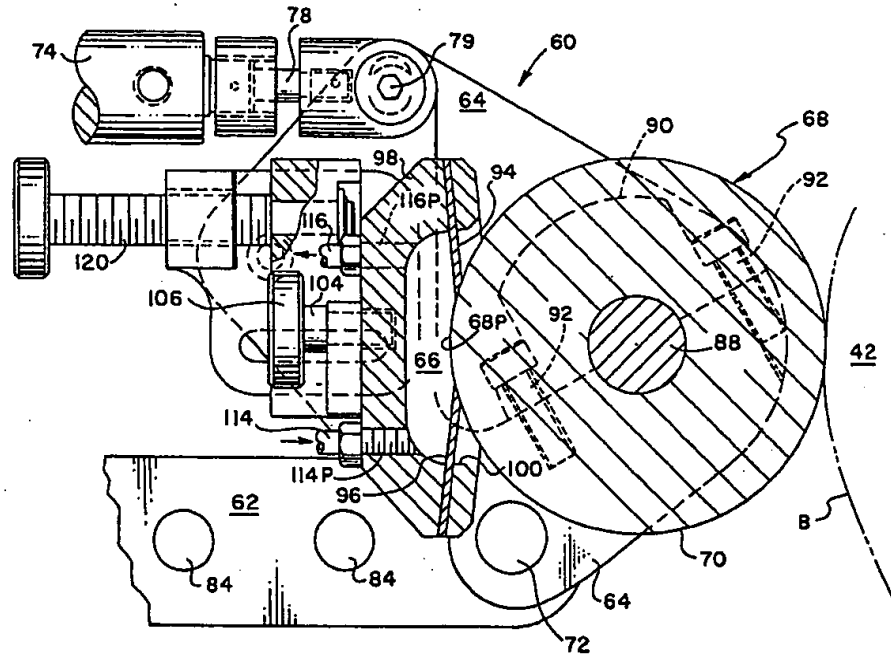


FIG. 4

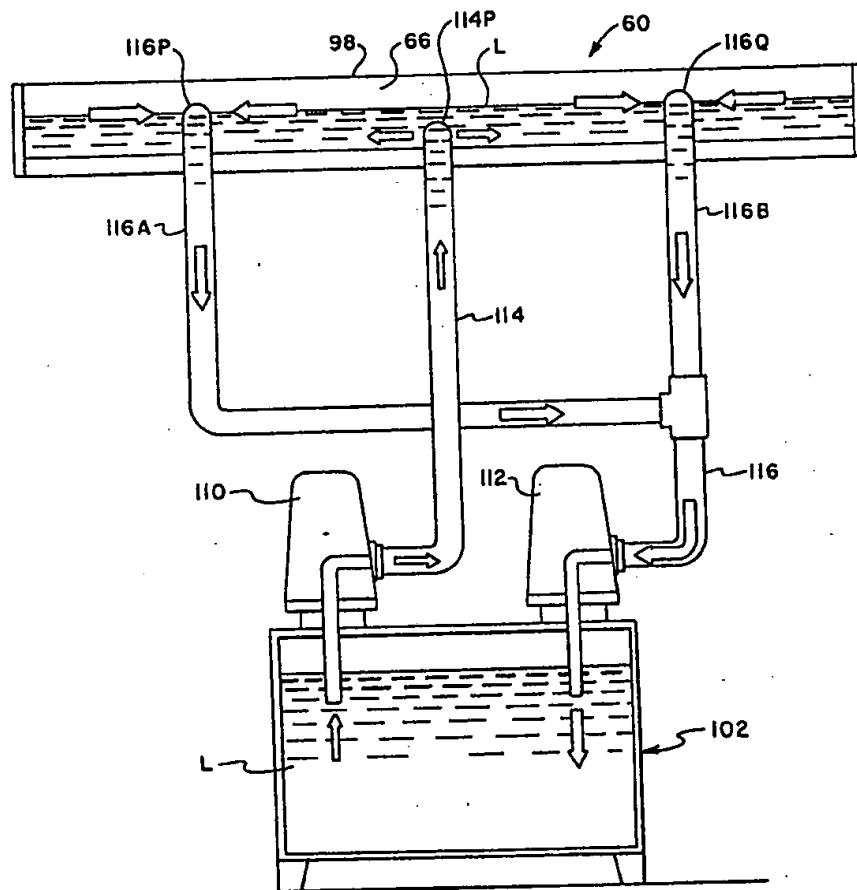


FIG. 5

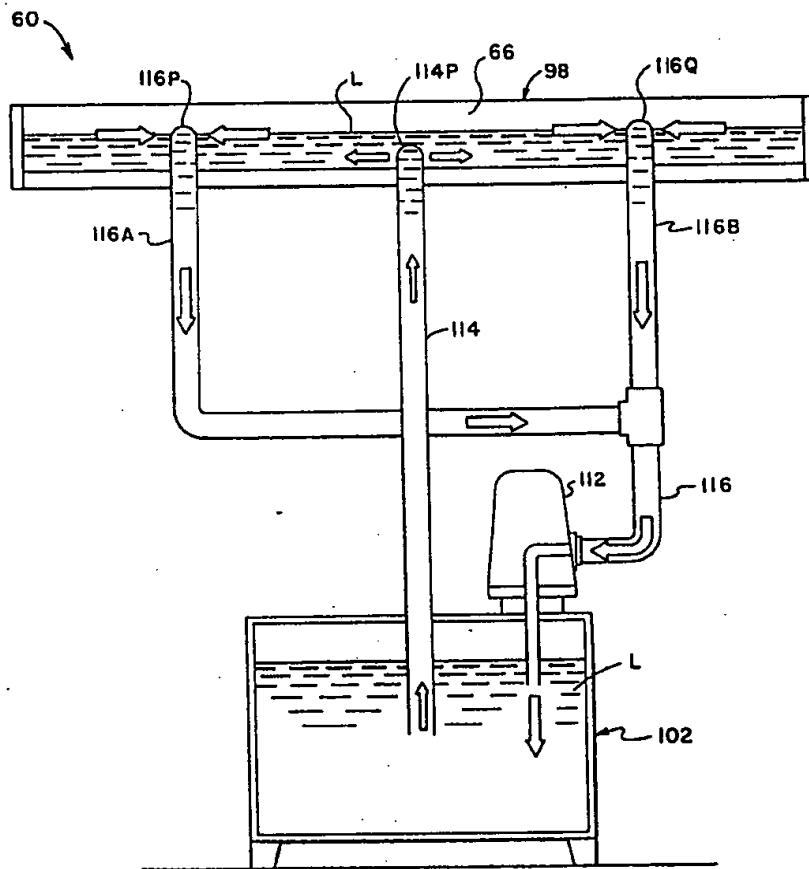


FIG. 6

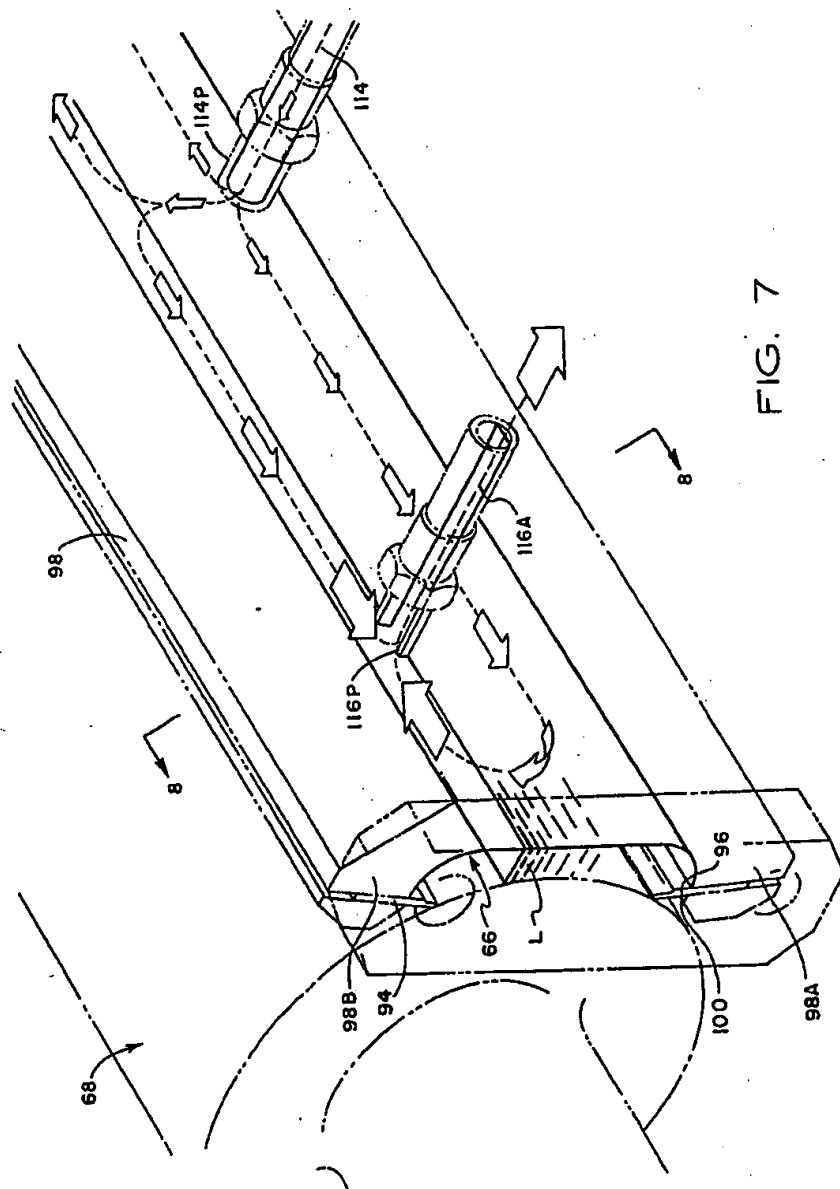


FIG. 7

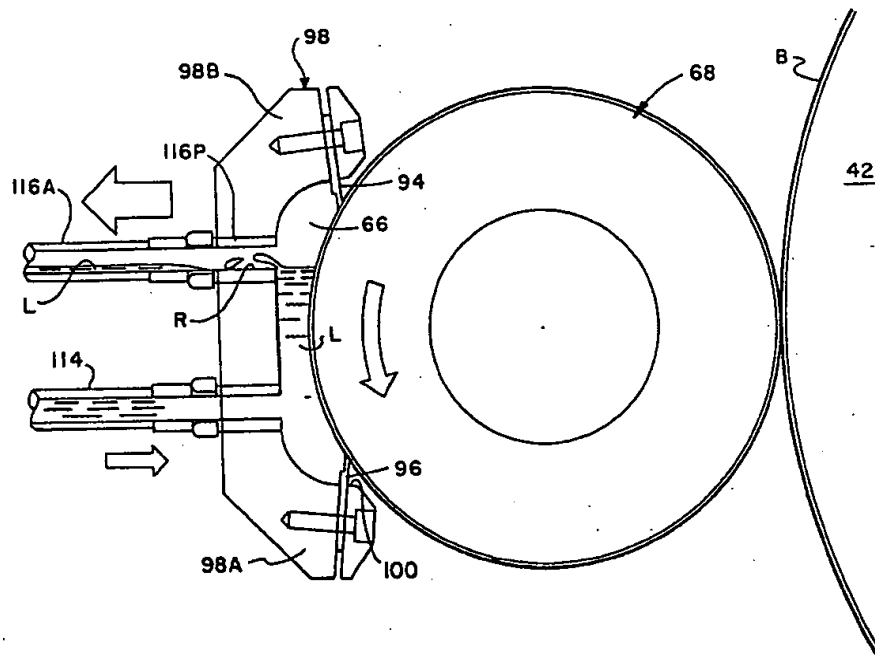


FIG. 8

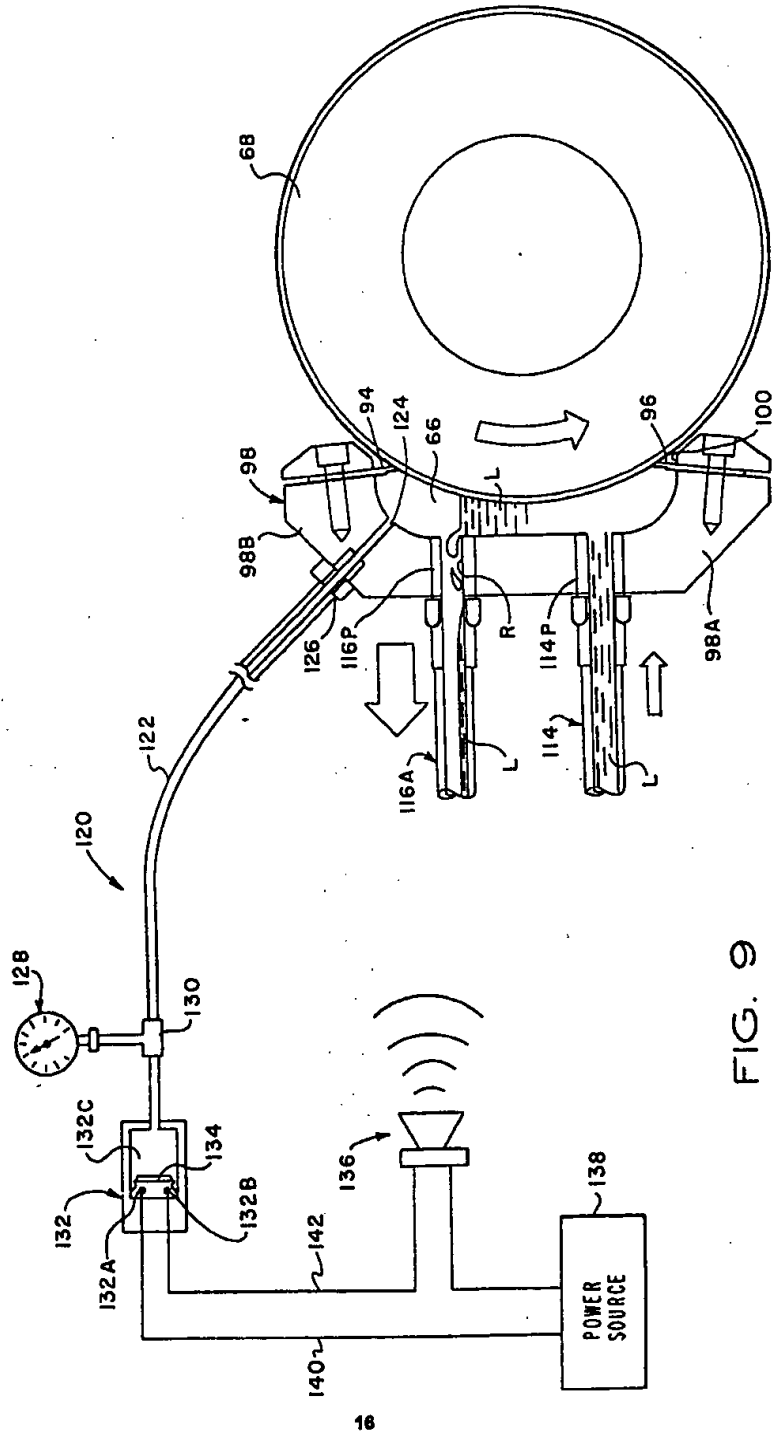


FIG. 9

European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 3265

DOCUMENTS CONSIDERED TO BE RELEVANT			Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Category	Citation of document with indication, where appropriate, of relevant passages	TECHNICAL FIELDS SEARCHED (Int. Cl.5)		
A	EP-A-0 461 426 (ROCKWELL INTERNATIONAL) ----		B41F23/08 B05C1/08	
A	US-A-4 879 949 (ILDVACO ENGINEERING) -----			
The present search report has been drawn up for all claims				
Place of search THE HAGUE		Date of completion of the search 27 SEPTEMBER 1993	Examiner LONCKE J.W.	
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>				

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